

Increases in Serum Erythropoietin Hormone in Recreational Breath-Hold Divers Following a Series of Repeated Apnoeas: Apnoea beyond Freediving

Authors : Antonis Elia, Theo Loizou, Gladys Onambele-Pearson, Matthew Barlow, Georgina Stebbings

Abstract : Hypoxic conditions have been reported to enhance red blood cell production in both acclimatised low-landers and altitude adapted populations. This process is mediated by the erythropoietin hormone, which is released predominantly by the hypoxic kidney. A higher haemoglobin concentration was previously reported in elite breath-hold divers when compared to elite-skiers and untrained individuals. Therefore, the present study aimed to investigate whether apnoea induced hypoxia could induce a significant increase in serum erythropoietin concentration in recreational breath-hold divers which would provide an explanation to the higher haemoglobin levels observed in elite breath-hold divers. Identifying whether apnoea induced hypoxia induces a significant increase in serum erythropoietin might suggest that apnoea can be used as an alternative acclimatisation method to high altitude exposure. Seven healthy, recreational male breath-hold divers performed two sets of five 180 second breath-holds with a ten-minute supine rest between each set and a two-minute seated rest between each apnoea. During each breath-hold, participant's heart rate and peripheral oxygen saturation levels were recorded every subsequent 10 seconds until the end of the 180 second breath-hold. After each 180 second breath-hold a capillary blood sample was collected from the finger to identify circulating haemoglobin levels. Following completion of the apnoeic protocol, three blood samples were collected at 30, 90 and 180 minutes to measure circulating erythropoietin levels. A significant interaction between erythropoietin and time was observed ($F(3,18) = 4.72, p < 0.001$), with significant increases in erythropoietin evident at 30 ($t(6) = -5.035, p < 0.0590$) ($t(6) = -6.162, p < 0.05$) and 180 ($t(6) = -7.232, p < 0.001$) minutes post the last apnoea when compared to baseline. Corresponding average increases when compared to baseline were 16% at 30, 23% at 90 and 40% at 180 minutes post the last apnoea. A significant interaction between haemoglobin and time was observed ($F(78,84) = 20.814, p < 0.001$), with significant increases in haemoglobin evident at the fifth ($t(29) = -1.124, p < 0.001$), ninth ($t(29) = -1.357, p < 0.001$) and tenth ($t(29) = -1.211, p < 0.05$) apnoeas when compared to baseline. A significant interaction between peripheral oxygen saturation and time was observed ($F(10,60) = 408.23, p < 0.001$). The present study demonstrates that a series of ten 180 second breath-holds is sufficient to induce a significant increase in the circulating erythropoietin concentration of recreational breath hold divers. These observations may suggest that apnoea induced hypoxia may be used as an alternative acclimatisation method to high altitude exposure.

Keywords : apnoea, breath-holding, diving reflex, erythropoietin, haemoglobin

Conference Title : ICMSEE 2016 : International Conference on Medicine in Space and Extreme Environments

Conference Location : Paris, France

Conference Dates : July 25-26, 2016